

# Low Birth Weight and Perinatal Mortality

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A RECENT STUDY by the National Center for Health Statistics, Public Health Service, was concerned with the higher and more slowly decreasing perinatal and infant mortality in the United States compared to six West European countries, one of which was Sweden (1). In 1964 the U.S. infant mortality rate was highest among the seven countries and 75 percent higher than the lowest rate, that for Sweden. Even when the comparison was limited to white infants in the United States, the rate was 52 percent higher than in Sweden.

In each of the countries studied, the decline of both infant and perinatal mortality was retarded after 1950, but the slowing down was more evident in the U.S. rate than in all but one of the others. According to the Public Health Service study, the differences cannot be explained by factors such as age of the mother or birth order of the child. The data show that the incidence of low-birth-weight infants is higher in the United States and that it has been slowly increasing. The data also suggest that differences in birth weight distribution could account for as much as 85 to 90 percent of the differences in neonatal mortality between the United States and Sweden. The comparison is hampered, however, by insufficient data on birth

weight from the European countries and by lack of U.S. data on weight-specific mortality rates later than 1950.

## Swedish Data

Swedish data on the proportion of low-weight births are available in the statistical reports of the National Board of Health which are published yearly, with a delay in time of 1½ to 2 years so that the latest report contains the statistics for 1965. For birth statistics, the following recommendations of the World Health Organization have been adopted: (a) the dividing line for prematurity is set at 2,500 grams, (b) "live birth" includes all infants who are breathing or show any other sign of life independent of the gestational age, and (c) "late fetal death" or "stillbirth" includes fetuses born without any evidence of life at 28 or more weeks of gestation.

Since 1965, data have been collected from all of Sweden on birth weights, in 500-gram groups, 2,500 grams or less and the late fetal and early neonatal mortality in those groups. These data were published for the first time in the 1967 report of the National Board of Health (2).

The primary source for the statistics of the National Board of Health is the yearly reports from hospitals, which cover more than 99.8 percent of all childbirths in Sweden. The remaining 0.2 percent represents domiciliary deliveries attended by district midwives, whose birth reports also reach the Board through the provincial health officers. The birth and death data of the National Board of Health correspond well with the official vital statistics which are collected in

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the parish registries and computed by the Central Bureau of Statistics.

By using the statistics of the National Board of Health it is possible to make international comparisons on prematurity which go beyond those in the 1967 study (1). As background to my subsequent discussion on the maternal health programs in Sweden, such information should be of interest.

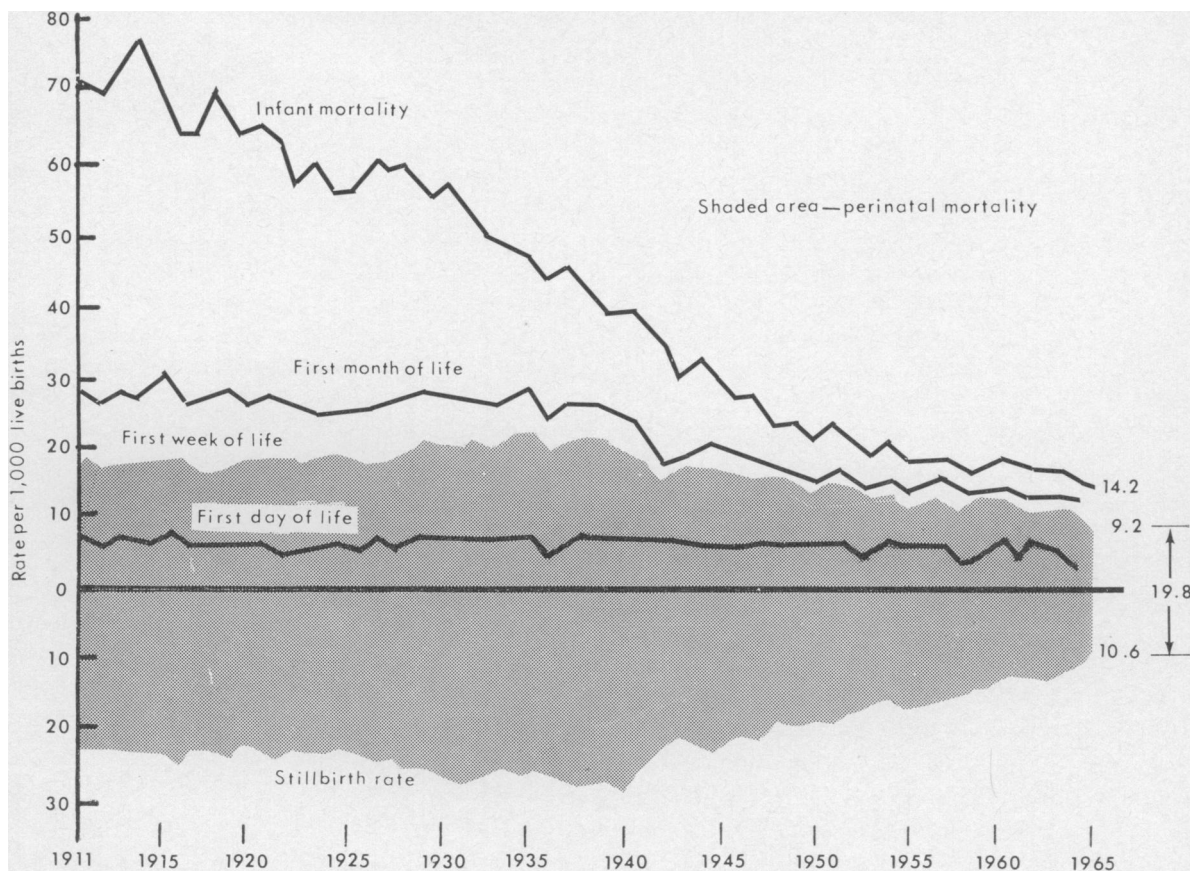
The mortality within the first day, week, month, and year of life, as well as late fetal deaths per 1,000 live births in Sweden, from 1911 to 1965, illustrate the dynamic changes which have occurred and are still in process (fig. 1). Since 1943, the early neonatal mortality has dominated the losses during the first year of life, and it accounted for almost two-thirds of such losses in 1965.

Figure 2 shows that for perinatal mortality there has been a gradually increasing relative dominance of low-weight infants from 1955 to

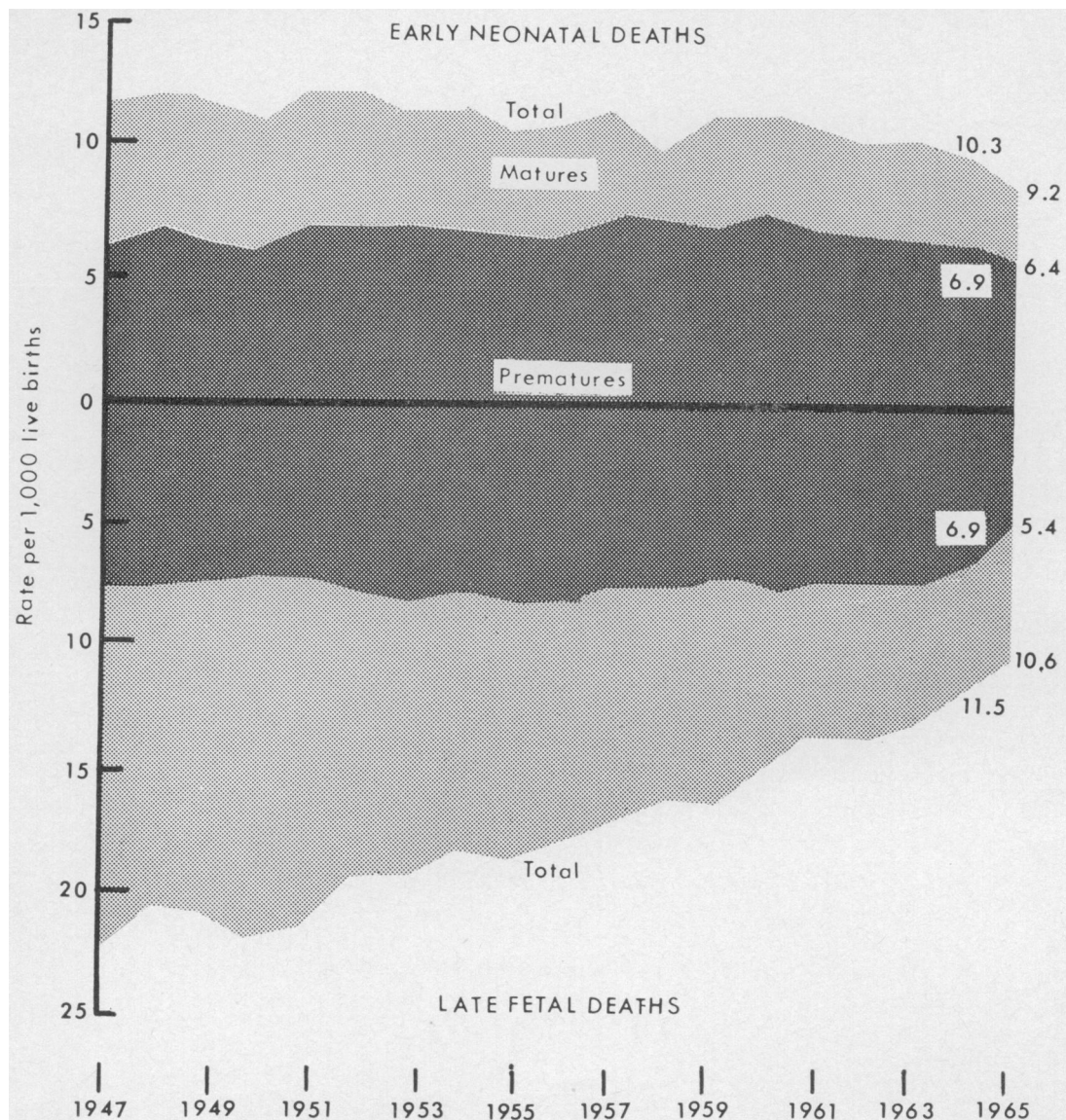
1965. In 1965 the "prematures" accounted for about three-fifths of the total perinatal mortality. This proportion is related particularly to a continuous decrease in the fetal death rate of the "matures." In the early neonatal deaths, the prematures dominated throughout this 10-year period. A small increase in the proportion of premature births was also seen at the beginning of the period (fig. 3); however, this increase can be related mainly to a change in definition of premature.

Although low-weight infants constitute less than 5 percent of the total number, their high early neonatal death rate causes their dominance in the perinatal mortality. To be able to show in the same graph (fig. 4) the death rates of the prematures and the matures, the scale of the latter must be made 10 times larger. In 1965, the Swedish perinatal mortality of the prematures was 28.4 times that of the matures. From figures 2-4, it is evident that little change has occurred

**Figure 1. Infant, neonatal, and perinatal mortality per 1,000 live births, Sweden, 1911-65**



**Figure 2. Perinatal mortality per 1,000 live births, Sweden, 1947-65**



in the outcome of low-weight births in Sweden. The progress made in lowering the perinatal mortality was due mainly to the considerable drop in the late fetal death rate together with some decrease in the early neonatal mortality, both with respect mainly to infants weighing more than 2,500 grams.

Thus it is probable that Sweden's fortunate position in infant and perinatal mortality is caused to a high degree by a comparatively low rate of low-weight births. Another factor of possible importance is the weight distribution of live births in the United States and Sweden

(table 1). The only recognizable difference in the distribution under 2,500 grams is in the lowest weight group where the U.S. figure is relatively higher—about 7 percent of the live-born prematures as against 4 percent in Sweden. However, this difference is of considerable importance as the lowest weight group has a high early neonatal mortality; in Sweden one of four early neonatal deaths among the low-birth-weight infants occurred in this weight group. The early neonatal mortality and the perinatal mortality by weight are shown in table 2.

Table 3 demonstrates the significance of the

rate of low-weight births for the national differences. The 1964 data show how the Swedish early neonatal mortality would have been affected if only the prematurity rate had been increased to the U.S. level the same year. For the 1959 data the reverse experiment is done, using the latest available figures for weight-specific neonatal mortality in the United States (3). It is evident that the national differences decrease or disappear through such manipulations.

For the purposes of table 3, only the weight was considered as a criterion for the maturity of the child at birth. It has been suggested that newborn children from certain minority groups in the United States, especially from the Negro population, show a comparatively higher maturation at lower birth weight. If this observation is correct, it should increase the difference in the total perinatal mortality between the two nations. The fact that the United States and Sweden show a significant difference in prematurity rates, despite their similar levels of general development, motivates a search for possible determinants of that difference.

#### Socioeconomic Factors

Studies in the United States and in Sweden demonstrate that women of the least favored social groups, unmarried women, and women in less-skilled occupations have an increased tendency to give birth to low-weight infants.

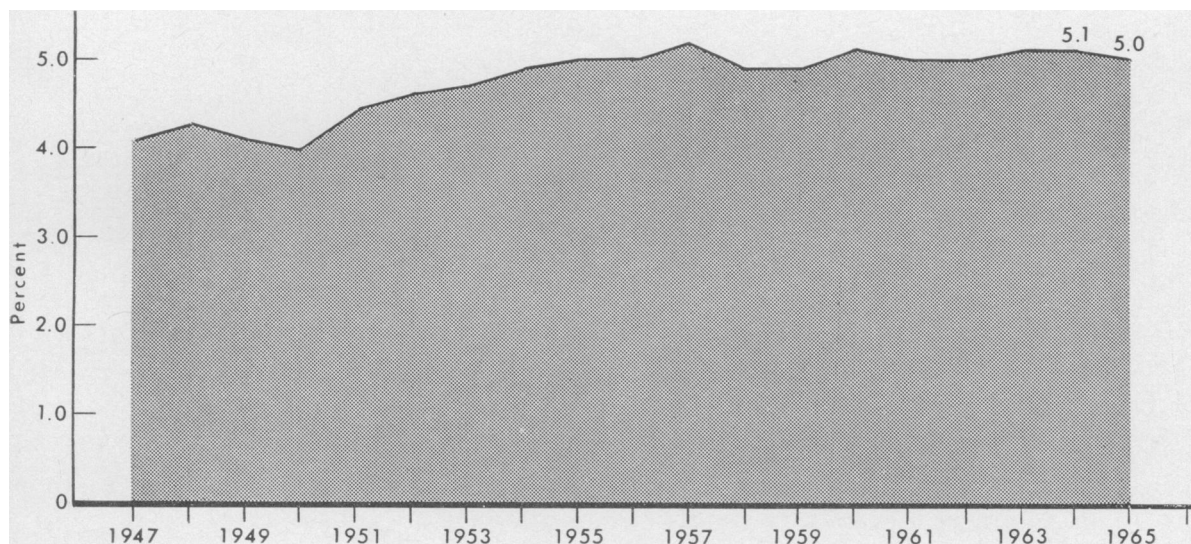
**Table 1. Percentage distribution of live births by birth weight, United States and Sweden**

Birth weight (grams)	United States 1964	Sweden 1965
1,000 or less-----	0.6	0.2
1,001-1,500-----	.7	.4
1,501-2,000-----	1.5	1.0
2,001-2,500-----	5.4	2.9
2,501 or more-----	91.8	95.6

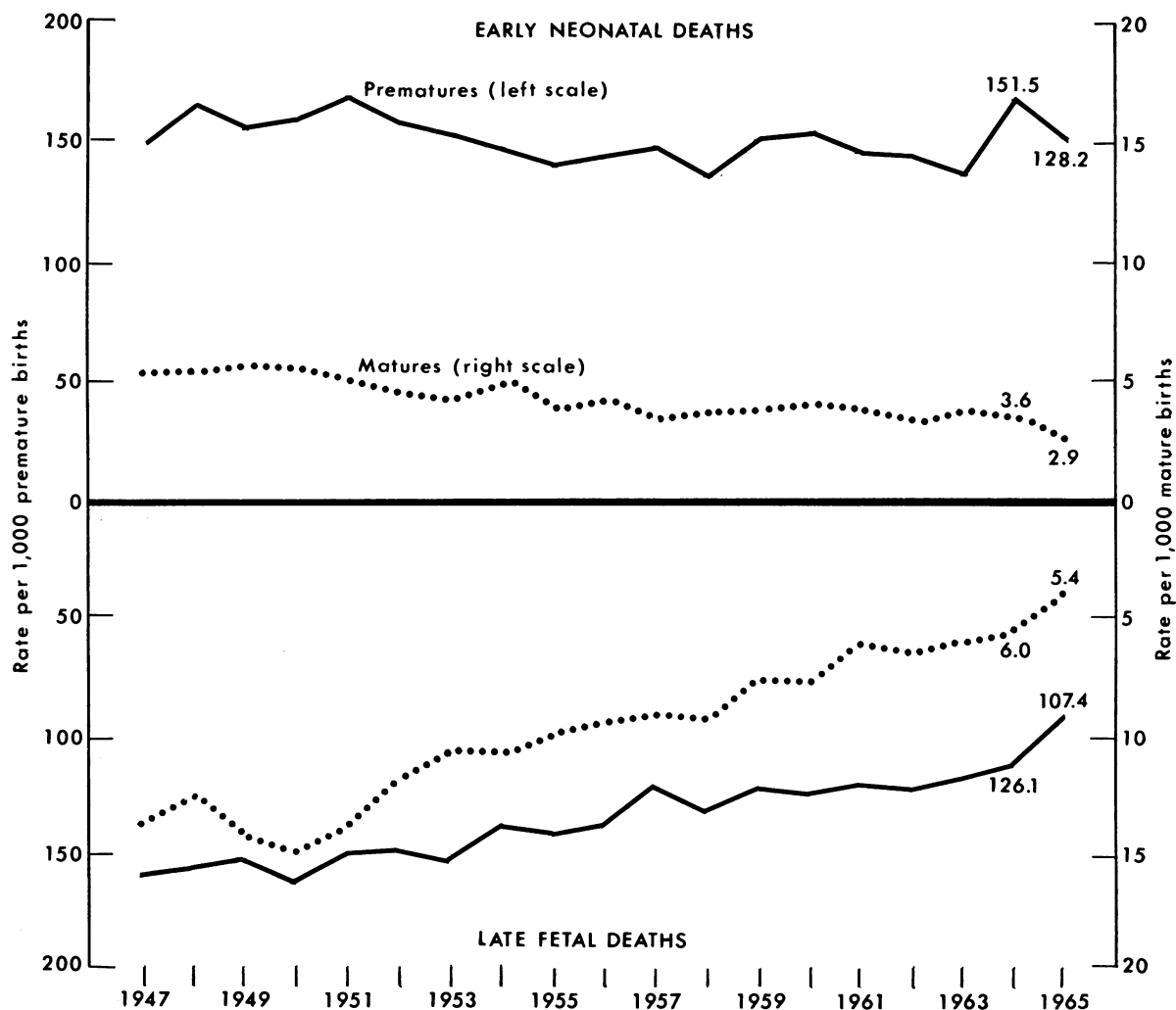
However, no study seems to have been made in the two countries or elsewhere which can serve as a basis for an evaluation of the impact such socioeconomic factors may have on the national statistics, and thus enable international comparison.

General demographic data indicate important sociologic and economic differences between Sweden and the United States, which may have consequences in infant mortality. Sweden has a small population of about 8 million, which is slowly increasing with a growth rate of 0.6 percent per year. The birth rate is one of the lowest in the world, in 1966 close to 16 per 1,000, and the death rate is around 10 per 1,000. The growth rate of the U.S. population is a third larger. The Swedish population is also rather homogeneous; there are no minority groups with significant fertility differences, as in the United States.

**Figure 3. Percent of total births 2,500 grams or less, Sweden, 1947-65**



**Figure 4. Late fetal deaths and early neonatal deaths, Sweden, 1947-65**



Sweden is a highly developed and industrialized country with the highest per capita income in Europe, along with Switzerland. Although the gross national product of \$2,400 per capita in 1964 was only about half the U.S. figure, Swedish standards of living are high, and, more important for health standards, the prosperity is far more equally distributed than in the United States; there are few very rich people but also few really poor ones. With some exaggeration, Sweden has been described as approaching the stage of having only one solid middle-class population. Even though there is a considerable housing shortage caused by pronounced urbanization, especially in the major cities, city slums are virtually non-existent.

Much of what is included in the social reforms of a welfare state like Sweden should be of considerable importance for health in general and for maternal and child health in particular, although it is impossible to prove in figures if and to what extent such reforms should be given credit for the progress made.

Since 1962, Sweden has had compulsory health insurance for all residents. Most of the cost is paid by the insured together with his income tax, with a premium according to his income; part is paid by the employer and part by the Government. The insured gets hospital care without charge, both for illness and for childbirth. For outpatient care there is a 75 percent refund of fees to the physician, to the hospital, or to the laboratory, according to a

schedule of the services provided, and also of travel costs of the patient to the physician or of the physician to the patient. Half the cost of medicine over a low basic price is paid by the insurance, and more expensive medicines as well as some medicines for chronic diseases and during pregnancy are free of charge. There is a cash sickness benefit with a supplement to gainfully employed persons according to income. Similarly, a cash maternity grant of about \$215 is available to everyone and can be supplemented for a maximum of 180 days by an additional cash benefit according to income, if the mother was employed 270 days before confinement.

Apart from the benefits under health insurance, the social security of mothers is further enhanced by yearly family allowances of \$100–\$120 per child until the age of 16, or 18 for students. All these benefits are provided independently of the marital status of the woman.

The term “illegitimate” for many years has been canceled from all law texts and replaced by the term “out-of-wedlock.” Unmarried motherhood carries much less social stigma in Swedish society than in North America, and certain social services are offered specifically to unmarried mothers. A guardian is always appointed by the Child Welfare Board of the home community. One duty of the guardian is to try to find the father of the child and make him admit his social and economic responsibilities, if necessary by bringing the case to court, and to help the mother in representing the child in all legal and economic matters. If no father can be found, the Government provides a special cash allowance to support the child so long as the mother needs it.

Out-of-wedlock births are almost twice as

**Table 2. Early neonatal and perinatal mortality,<sup>1</sup> by birth weight, Sweden, 1965**

Birth weight (grams)	Early neonatal mortality	Perinatal mortality
1,000 or less.....	881. 3	1, 255. 7
1,001–1,500.....	475. 9	857. 4
1,501–2,000.....	153. 7	304. 9
2,001–2,500.....	47. 5	104. 0
2,501 or more.....	2. 8	8. 2
Total.....	9. 2	19. 7

<sup>1</sup> Per 1,000 live births.

**Table 3. Incidence and mortality of premature infants, Sweden and the United States**

Year and location	Percent live births 2,500 grams and under <sup>1</sup>	2,500 grams and under	More than 2,500 grams	Total
<b>1964</b>				
Sweden <sup>3</sup> -----	4. 6	151. 5	3. 6	10. 3
United States <sup>3</sup> -----	8. 2	-----	-----	17. 9
Sweden <sup>4</sup> -----	-----	-----	-----	15. 7
<b>1959</b>				
California <sup>3</sup> -----	7. 2	172. 9	4. 8	17. 3
Sweden <sup>3</sup> -----	4. 5	-----	-----	12. 8
California <sup>5</sup> -----	-----	-----	-----	12. 4

<sup>1</sup> Incidence of prematurity.

<sup>2</sup> Per 1,000 live births.

<sup>3</sup> Actual.

<sup>4</sup> Calculated with U.S. incidence and Swedish weight-specific mortality.

<sup>5</sup> Calculated with Swedish incidence and California weight-specific mortality.

SOURCES: references 1, 2, 4, and 5.

common in Sweden (13.1 percent) as in the total U.S. population (6.8 percent), but only about half as frequent as among U.S. nonwhites (24.5 percent). Several studies indicate that the prematurity rate is higher in unmarried than in similar control groups of married women. However, the studies do not allow statistical international comparisons. Such comparisons may also be difficult because the basic data can be misleading, as the traditional attitudes and behavior with respect to marriage and childbearing vary in different countries and in different socioeconomic and cultural groups in the same society. For instance, a great number of so-called out-of-wedlock children in Sweden are born to parents who marry after the first childbirth, an accepted custom since old times when proved fertility could be a prerequisite for marriage.

### Maternal Health Services

Swedish pregnant women are prohibited from taking or continuing heavy manual labor. Every employer is required to allow an employee leave during the last 6 weeks of her pregnancy and up to half a year after the child-



birth and also to grant her necessary time off if she is breast feeding her child. He must re-employ her after the childbirth if she has expressed beforehand that she wishes to return to the job.

Organized care for pregnant women was not introduced in Sweden until early in this century. Originally, private physicians provided such care, and their aim was primarily directed toward early discovery of albuminuria in pregnant women and prevention of eclampsia. Their initiative was eventually followed by the establishment of outpatient clinics with similar aims in a few hospitals in the country. A Government pilot project was started in 1931 in several urban and rural areas. Some years later, the National Board of Health published a report and a plan for the organization of a general maternal and child health (MCH) service in the country (6). A 1938 statute established the rules for state grants to the local governments for this service. The statute has since been revised and updated several times.

A condition for the grant is that the care is given free to the patients. The maternal health part of the activities is mainly preventive prenatal care but also provides for postnatal examination and advice on family planning. Free testing for pregnancy is included to stimulate first visits as early as possible in pregnancy. Education for childbirth classes are arranged and conducted by the midwife in charge. In addition to preventive care, there is also provision for treatment of diseases during pregnancy and up to 12 weeks after the delivery, if the diseases are caused by the pregnancy or delivery and when inpatient care is not necessary. This provision is in addition to the general sickness insurance. Other free services included are a serologic test for syphilis, chest X-ray screening, blood-typing, at least for Rh factor, and often vaginal cytology and bacteriological culture for gonococcal infection. The examination of every pregnant woman with respect to asymptomatic bacteriuria, either by quantitative bacteriological culture or by a chemical screening test, is being carried out in some centers as a pilot study.

As mentioned earlier, certain medicines are given free of charge to pregnant women. These include both prophylactic and therapeutic

drugs; for example, vitamins, iron, and calcium. More recently, immune or gamma globulin has been added to the free medicines to be given for protection to women exposed to rubella in early pregnancy.

The MCH services are administered by medical committees of the governments of the 25 Swedish Provinces and three separate cities. Each committee plans for its own area in consultation with the National Board of Health. The Board issues instructions for the MCH services, stating the aims of the care and the organization of the activities.

Where there is a hospital with a separate department of obstetrics and gynecology, the maternal health service is provided by a center staffed by specialists and usually directed by the head physician of the department. In some of the larger cities, centers of the same highly qualified type are also located outside of the hospitals. In this type of center, only midwives with special training in preventive obstetrics may be employed. In other urban areas, the care is given by less specialized personnel, often the medical and midwifery staff of the general hospital which is providing the delivery services, or the city medical officer and district midwives.

In rural areas, preventive maternity care is provided by the district medical officer, and the district midwife is responsible for midwifery duties. If the district covers a large area, branch centers may be arranged to avoid long trips for the pregnant women. The centers are usually used for combined MCH services, and the midwife is replaced by the district public health nurse for the well-baby clinics.

After their introduction in 1938, the Swedish maternal health services expanded rather rapidly, and during the past 10 years the country has been fairly sufficiently covered, although the rural areas with sparse population and lower fertility are not as well supplied as the cities. Another determinant of the rural backwardness in this respect has been a shortage of district midwives.

Since there are no domiciliary deliveries, the midwifery districts have been expanded in order to fill the time of the midwives with maternal health work. The young, newly graduated midwives prefer to take positions in the maternity wards of the hospitals where they can

practice the delivery care for which they have received their principal training and which they feel is more rewarding. In sparsely populated northern Sweden, some communities have solved this problem by appointing district nurses with full training in both public health and midwifery, which, however, requires a long and expensive education.

Because education in obstetrical practice at delivery is not really necessary, a different way of midwifery training for nurses was tried. Public health nurses were given a 5-month training course in the theoretical and practical aspects of prenatal care and also in handling some obstetrical emergency situations which they might encounter. After this course, the nurses took over the maternal health work in their own and sometimes a neighboring district, where home delivery no longer can be the choice of pregnant women. The results of this experiment were favorable; they indicate that the advantages of effectiveness and continuity in care outweigh the disadvantages of incomplete midwifery training of the nurse. No serious complications have been recorded that can be charged to the experiment.

The instructions for MCH services recommend at least three consultations with a physician during a normal pregnancy—one visit in the beginning, one in the middle, and one about 4 weeks before the expected date of delivery. Whenever needed, the number of visits can be increased. Another visit to the physician is to be made 6 to 8 weeks after the childbirth. The main burden of regular care during pregnancy is assumed by the midwife, who makes monthly checkups in the early stages of the pregnancy, fortnightly between the second and last regular visits to the physician, and then weekly until the delivery. If possible, the midwife makes a home visit to every pregnant woman in her care. These aims correspond reasonably well to reality. The 1965 statistics show that women in the general maternal health service made an average of 3.4 visits to a physician and 6.3 visits to the midwife, and that the midwives made 0.5 home visit per patient. Naturally, more visits to midwives and home visits are made in rural areas, and more consultations with physicians take place in urban centers.

No statistics are available on the distribution of pregnant women by the different types of clinics, but the number of specialized centers has increased steadily, from 30 in 1945 to 75 in 1965, whereas the number of less-qualified centers has decreased. Between 80 and 90 percent of all the childbearing women receive prenatal care through the public services; the others prefer care by private physicians at their own expense. In recent years, rarely has a woman been admitted for delivery who has had no prenatal care.

As transportation facilities have improved, particularly in recent years when private automobiles have become generally available, prenatal care has become increasingly centralized. Also, the aim has been to have every pregnant woman examined at least once during pregnancy, by a specialist if possible, at the maternal health center of the hospital where she plans to deliver. In most accessible areas this aim seems to have been reached; in some places by having a member of the obstetrical staff of the hospital conduct the clinics of small and distant centers once or twice monthly.

Furthermore, the National Board of Health strongly recommends a consultation with a specialist for all high-risk pregnant women so that a joint decision can be reached on necessary precautions and on special care that may be needed. A major portion of the special care is directed to the prevention of prematurity. This system is also rewarding for the consulted specialist because the insight of the local physician into the personal and social circumstances of a patient may be extremely helpful for the specialist in making his evaluation. The system also seems to diminish substantially the incidence of late admittance to the maternity hospitals of patients in critical condition.

Especially since World War II, maternity care in Sweden has become increasingly specialized and largely concentrated in departments headed by physicians well qualified in obstetrics and gynecology. Presently, throughout the country there are more than 50 such departments which have about 70 percent of the total 3,600 maternity beds. In 1920 only 9 percent of all deliveries took place in a hospital; the statistics were more than reversed in 1965 when 0.1



percent of the deliveries were at home, 0.5 percent took place in small maternity homes without a resident physician, and three of four of the remaining 99.4 percent of the deliveries were in departments staffed with obstetrical specialists.

Most hospitals with a separate department of obstetrics and gynecology also have a pediatric department, and for several years it has been the policy of the National Board of Health never to sanction the building of such hospitals without pediatric departments. For other general hospitals, the Board recommends that a pediatric consultant be assigned to the maternity department at all times.

The influence on the incidence of prematurity and on the fate of the low-birth-weight infants of these efforts to centralize and specialize the

obstetrical care is difficult to evaluate. Some possibly favorable effects may be deduced from tables 4 and 5. Table 4 shows that the specialized hospitals had a comparatively higher proportion of low-weight births, mainly live births. To some extent, this may be influenced by a higher general incidence of prematurity in the usually highly industrialized communities which they serve in addition to prenatal screening and admission of high-risk patients.

Table 5 indicates that the slightly higher perinatal mortality for the low-weight births in the specialized hospitals makes their total perinatal mortality rate significantly higher, even though it is lower for the matures. However, the gradual increase in total perinatal mortality, combined with the gradual decrease in perinatal mortality for mature births, progressing from

**Table 4. Proportion of premature births, by type of place of delivery, Sweden, 1965**

Place	Percent of all live births	Live births 2,500 grams or less		Stillbirths 2,500 grams or less	
		Percent of all	Percent in each place	Percent of all	Percent in each place
Maternity hospital or hospital department with obstetrical specialists.....	75.0	80.0	4.8	79.6	53.1
Maternity department in general or cottage hospital without specialized staff.....	24.4	19.3	3.6	19.8	45.3
Maternity home without a resident physician..	.5	.4	3.0	0	0
Home.....	.1	.3	10.3	.6	( <sup>1</sup> )
Total.....	100.0	100.0	4.5	100.0	51.1

<sup>1</sup> Too few for calculation of rate.

**Table 5. Perinatal mortality, by type of place of delivery, Sweden, 1965**

Place	Number of live births	Live births 2,500 grams or less		Perinatal mortality rate		
		Number	Percent	2,500 grams or less	More than 2,500 grams	Total
Maternity hospital or hospital department with obstetrical specialists.....	91,837	4,393	4.8	264.7	8.1	20.4
Maternity department in general or cottage hospital without specialized staff.....	29,822	1,062	3.6	261.8	8.7	17.7
Maternity home without a resident physician..	636	19	3.0	( <sup>1</sup> )	13.0	15.7
Home.....	175	18	10.3	( <sup>1</sup> )	19.1	57.1
Total.....	122,470	5,492	4.5	264.0	8.3	19.8

<sup>1</sup> Too few for calculation of rate.

the least to the most highly specialized hospitals, is a result of successful screening of the high-risk patients for specialized care.

### Summary

An analysis of Swedish data on incidence and mortality of low-birth-weight infants and a comparison with available U.S. statistics indicates that the higher U.S. infant and perinatal mortality is caused mainly by a higher proportion of low-weight births. Possible reasons for Sweden's more favorable position in this regard may be found in its lower birth rate, its homogeneous population which has no underprivileged minority groups, its social welfare system and compulsory health and sickness insurance, and its well-developed and highly specialized prenatal and maternity care.

All prenatal, delivery, and postnatal services are provided free of charge to everyone as a part of the general health insurance. A screening system is used to detect women at risk for premature birth or other obstetrical complications so that they may be given specialized prenatal and delivery care. As a probable result, 75 percent

of all Swedish children—but 80 percent of the prematures—are born in maternity hospitals or hospital departments which have obstetrical specialists. The resources of a modern hospital are not immediately available for less than 1 percent of all pregnant women.

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### Tearsheet Requests

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